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Experimental investigation of residence time distribution in twin-screw granulation

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The residence time distribution (RTD) in a twin-screw granulator (TSG) contains interesting information about mixing and different granulation rate processes such as growth and breakage during granulation. In this study, near infra-red (NIR) chemical imaging was used to characterise the impact of process (feed-rate (MFR) and screw-speed (N)) and equipment parameters (number of kneading discs (NK) and stagger-angle (SA)) on the RTD. Moreover, mean residence time (MRT) and variance values were calculated and used to characterise the macro-mixing in the axial-direction through the Péclet number (Pe) and number of equally sized stirred tanks (n) from Tank-in-series (TIS) model. Results showed that MRT of powder in the barrel were mostly influenced by N, followed by NK and SA. The mixing regime reflected by Pe and n showed that MFR and SA, although having much less effect on MRT, played a significant role in macro-mixing at high barrel filling conditions (low N and high MFR), reflected by almost doubling of n (from 10 at 30º to 22 at 60º). The latter indicates an increase in axial segregation. These results contribute to the understanding of back-mixing in TSG and form the basis for improved physical models of twin-screw granulators.

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